tion was also made at this place and a stop-watch record was taken by Professor Clarke.

Professor Paul established himself with a mercury apparatus on Staten Island, about fifteen miles away. Professor Hallock, of the geological survey, who joined the party at New York, occupied a station at Yonkers, distant about ten miles, where he was fortunate in securing the co-operation of Mr. Thomas Ewing, Jr., of Columbia college. Mr. Hallock observed with a mercury apparatus and chronometer; and Mr. Ewing used a seismoscope, noting the time of the 'drop' by a stop watch. Professor Rees of Columbia entered enthusiastically into the work, and used a seismoscope with a chronograph and a mercury apparatus with chronometer at the college observatory. It was planned to place an observer at the meteorological observatory in Central park, opportunity for which had been kindly offered by Dr. Draper, but at the last moment no one was available for that point. Dr. Draper, however, made a number of interesting observations on the behavior of his self-registering meteorological instruments, getting a record of the shock from nearly all of them. Astronomical observatories in the vicinity of New York had been notified; and, in a number of them, observers were anxiously awaiting the appearance of the ripple on the surface of the mercury.

Unfortunately the firing of the mine was delayed nearly fourteen minutes. This, however, did not prevent good observations at several points. From Ward's Island the movements of the men on Flood Rock were easily noted, and the observer was not obliged to begin his watch until the last steamer had left the rock, and it was known that the explosion could be expected very soon.

It is impossible to describe the appearance of the river an instant after the mine was fired. A mass of water covering several acres seemed to have been instantly lifted to a height variously estimated at from one hundred to two hundred and fifty feet. It has been several times described as resembling a gigantic iceberg; and for a moment no more fitting term could have been applied. The seismoscope left its record of the initial disturbance on the chronograph sheet, and behaved throughout in a most satisfactory manner.

At Yonkers, in spite of a prolonged observation, covering about eighteen minutes, the wave was 'caught' by both the mercury dish and the seismoscope, the times observed agreeing within one-fourth of a second. The seismoscope used by Professor Rees and his assistant, Mr. Jacobi, at Columbia college, recorded the passage of several railway trains before the explosion occurred; but it was always reset, and did its work promptly when the time arrived. The long delay was the cause of a failure at the Staten Island station, occupied by Professor Paul. He recorded in his note-book a disturbance of the mercury at about three minutes past eleven, but expressed his doubt as to its being due to the explosion. After waiting six or eight minutes, he decided that this disturbance was genuine, or that the explosion had occurred and had failed to reach him, and ceased his observations. It is greatly to be regretted that a record was not secured on Staten Island, as it would unquestionably have been, had the event occurred within a reasonable limit of the moment previously fixed. Observers at astronomical observatories away from New York have not yet been directly heard from, but it is feared that the delay of fourteen minutes prevented observations being made at many points where the wave might be expected to make itself felt. The telegraph reports an observation at New Brunswick, which was doubtless, like Professor Paul's, due to some other cause, and which prevented the observer from afterward getting the true wave. But report comes in the same way that Professors Young, Rockwood, and McNeill, were entirely successful at Princeton. Altogether it is believed that a sufficient number of reliable observations will be reported to be of great value, and the results of their reduction will be looked for with much interest.

It is not likely that another opportunity of this kind will occur in the near future; but from the experience of this occasion it is easy to see the importance of having the origin of the disturbance surrounded by a considerable number of stations at varying distances, at each of which a seismoscope with chronograph is used, so that where possible the record may be automatic; and it would also be extremely desirable to arrange that those in charge of the firing should agree to some plan, by means of which if the explosion did not occur at a definite hour previously announced, it should be postponed for ten minutes, and if not then ready, for another ten, and so on. In this way observers at a distance would be almost certain of success.

It ought to be added that the work of planning and arranging for the observations above noted was necessarily hurried, that it was undertaken and carried out under circumstances by no means favorable, and that it falls far short of what was desired and hoped for by those engaged in it.

T. C. Mendenhall.

DISINFECTION.

Disinfection consists in the destruction of something infectious, and we fail to see any justification for the popular use of the term which makes

it synonymous with deodorization. From our point of view the destruction of sulphuretted hydrogen, or of ammonia, in a privy vault is no more disinfection than is the chemical decomposition of these gases in a laboratory experiment. But when we destroy the infecting power of vaccine virus, or of the blood of an animal dead of anthrax, we disinfect this material no matter where it may be. "There can be no partial disinfection of such material; either its infecting power is destroyed or it is not. In the latter case there is failure to disinfect. Nor can there be disinfection in the absence of infectious material" (Preliminary report of committee on disinfectants of the American public health association).

Using the term then, in this restricted and scientific sense, what tests have we of disinfection, and what are the best disinfectants? The evidence of disinfection must evidently be based upon experiments which show that the infectious material has lost its specific infecting power. Such evidence we obtain from three sources: (*a*) practical experience in the use of disinfectants; (*b*) inoculation experiments upon susceptible animals; (*c*) biological experiments upon pathogenic micro-organisms—the test being failure to multiply in a suitable culture-medium after exposure to the disinfecting agent in a given proportion for a given time.

Until guided by exact data obtained in the laboratory the progress of our knowledge relating to disinfection was slow and uncertain. While agents now recognized as efficient were frequently resorted to in the pre-scientific period, they were often used by the sanitary authorities of the day in amounts entirely inadequate for the accomplishment of the object in view; and for the vulgar a disinfectant was a charm which was supposed to exorcise the disease-producing agent in some mysterious way. We must accord a certain value to the experiments of sanitarians in their efforts to restrict the extension of infectious diseases, although the evidence of successful disinfection offered by 'practical' men will not always stand scientific criticism. When a house in which a case of small-pox has occurred is fumigated with sulphurous acid gas, and this fumigation is followed by a thorough cleaning up, a liberal application of whitewash, and vaccination of everyone in the vicinity, it must always remain a matter of doubt whether the small-pox infection was, or was not, destroyed by the fumigation. In experiments made in practice—either clinical or sanitary—we have rarely any comparative test, and an undue value is often accorded to negative evidence. Laboratory experiments are, therefore, essential as a check upon 'experience,' and as a guide for successful practice.

Many experiments have been made directly upon infectious material, without reference to the exact nature of the infectious agent present in this material—the test of disinfection being failure to infect susceptible animals after treatment with the disinfecting agent. Of this nature were the experiments of Davaine upon the blood of animals dead with anthrax, or with infectious septicaemia; of Baxter and of Vallin upon the virus of glanders; of the writer upon septicaemic blood; and of numerous observers upon vaccine virus. The experiments upon dried vaccine—upon ivory points—are among the most satisfactory of these; for the inference seems to be quite safe, that whatever will destroy the specific infecting power of this material will also destroy the small-pox virus. The writer's experiments (1880) show very conclusively that chlorine and sulphurous acid gas are agents which may be relied upon for the destruction of the infecting power of this material—due regard being paid to the necessary conditions relating to quantity and time of exposure.

Since it has been demonstrated that the infecting power of certain kinds of infectious material is due to the presence of micro-organisms, numerous experiments have been made to determine the exact germicide power of a variety of chemical agents, as tested by these demonstrated disease-germs, and by non-pathogenic organisms belonging to the same class. These experiments show that, while the resisting power of organisms of this class differs within certain limits, in the absence of spores, a germicide for one of these organisms is a germicide for all. There is a wide difference, however, between the resisting power of spores, and that of bacteria in active growth. The growing plant—micrococcus, bacillus, or spirillum—is quickly destroyed by a temperature of from 150° to 160° F., while the spore resists a boiling temperature for several hours. Carbolic acid (2% sol.), sulphate of copper (1% sol.), and various other agents which are efficient for the destruction of active bacteria, fail in concentrated solution to kill spores. The experimental evidence on record indicates that the following named disinfectants are the most generally useful, from a practical point of view:—

Moist heat. A boiling temperature quickly destroys all known pathogenic organisms in the absence of spores. A temperature of 230° Fahr.—steam under pressure—maintained for ten minutes, will destroy spores.

Chloride of lime. A four per cent solution quickly destroys all micro-organisms, including spores. Labarraque's solution (liquor sodae chlorinatae) is equally efficient when of corresponding strength.

Mercuric chloride, in aqueous solution, in the proportion of 1: 10,000, is a reliable agent for the destruction of micrococci and bacilli in active growth, not containing spores; in the proportion of 1:1,000 it destroys the spores of bacilli, when they are fairly exposed to its action for a sufficient length of time (two hours).

Carbolic acid cannot be relied upon for the destruction of spores. This agent is recommended by Koch for the disinfection of the excreta of patients with cholera (5% sol.). A two per cent solution may be used for disinfecting clothing, etc.

Sulphate of copper is largely used as a disinfectant in France. It is efficient in the proportion of one per cent for the destruction of micro-organisms without spores; for excreta, use a five per cent solution.

Sulphurous acid gas is the most useful gaseous disinfectant, and is mainly relied upon for the disinfection of ships, hospital wards, etc. It is important for the destruction of spores, and exact experiments show that its disinfecting power, as determined by biological tests, has been very much over-estimated. For details, with reference to the germicide power of this and other disinfectants mentioned, the reader is referred to the preliminary reports of the committee on disinfectants of the American public health association, published in the *Medical news*, Philadelphia (Jan.–July, 1885).

GEORGE M. STERNBERG.

LIFE OF AGASSIZ.

IT is nearly twelve years since Agassiz died. Many tributes to his life have appeared in the meantime, the best of them being a memoir by his life-long friend, Guyot, which was communicated to the National academy of sciences. Now come his memoirs, edited (as the title page modestly expresses it) by his widow. Mrs. Agassiz was the person of all others best qualified for this work. Her entire familiarity with the scientific pursuits of her husband, her participation in his long journeys, her excellent style as a writer, and her calm and well controlled enthusiasm have enabled her to produce a volume which must give satisfaction to every one. She has avoided two obvious dangers, that of describing too minutely the incidents of domestic life, and that of leading the uninformed into the depths of zoölogical learning. She has drawn a portrait of the great naturalist,—let us rather say she has drawn a series of portraits, taken at different periods of life and in different attitudes, so that the man himself is before us, as the devoted student of nature, the brilliant lecturer, the correspondent of eminent men in every land, the good citizen, the bright companion, the hearty friend, the wonderful teacher.

The first of the two volumes is devoted to the European life of Agassiz, with which Americans generally are less familiar, and the second to his American career, which is not so well known in Europe. The proportions of the narrative are well preserved, and upon those who knew Agassiz well, and upon those who knew him only by name the same effect will doubtless be produced. As they read these pages they will see the man. He will appear as a personal and, perhaps, as a familiar acquaintance, returned once more to the scenes from which he has departed, and ready to open the stores of his memory, of his correspondence, and of his museums, to our eager attention. We have rarely, if ever, read a biography which brought the subject so vividly before the reader in the lineaments of life. One of the most charming chapters in the book is the first on the boyhood of the naturalist: it gives the key to all that is subsequent. We are here introduced to the parsonage at Motier, with its view of the Oberland, its garden and orchard with unblemished apricots, and its great stone basin into which a delicious spring was always pouring the water for Agassiz's first aquarium, and to the wise and discerning mother who understood that her boy's unusual love of nature was 'an intellectual tendency' to be developed by her aid, and who remained until her death—only six years previous to that of her gifted son—'his most intimate friend.'

From his earliest days onward, Agassiz's love of natural history was manifested: birds, field mice, hares, rabbits, guinea pigs and fishes were collected and studied. All sorts of handicrafts were also practised, and the future naturalist was not a bad tailor, cobbler, carpenter, and cooper. He acknowledged through life that his dexterity was largely due to these half sportive and half earnest pursuits of his childhood. At ten years of age he began his school life at Bienne, twenty miles from home, and there, during a period of four years, he received good training in Greek, Latin, French and German, and in various branches of natural science. A letter which he wrote at fourteen, showing what books he feels in need of, is a remarkable sign of his intellectual aspirations. During the next two years at Lausanne, he found a sympathetic teacher in Chavannes, who possessed the only collection of natural history in the Canton de Vaud, and a good counsellor in his uncle, Dr. Mayor, a physician of note, who

[1] *Louis Agassiz, his life and correspondence.* Edited by ELIZABETH C. AGASSIZ. Boston, *Houghton, Mifflin & Co.*, 885. 2 vols. Illustr., portr. 12°.